JANUARY 1957

SOIL CONSERVATION

Soil Conservation Service • U. S. Department of Agriculture

SOIL CONSERVATION

JANUARY 1957

VOL. XXII—NO. 6

EZRA TAFT BENSON
SECRETARY OF AGRICULTURE

DONALD A. WILLIAMS
ADMINISTRATOR, SOIL CONSERVATION SERVICE

OFFICIAL ORGAN OF THE SOIL CONSERVATION SERVICE
U. S. DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

★ THIS MONTH ★

SOIL CONSERVATION is published by direction of the Secretary of Agriculture as administrative information required for proper transaction of the public business. The printing of this publication has been approved by the Bureau of the Budget, July 18, 1955. SOIL CONSERVATION supplies information for workers of the Department of Agriculture and others engaged in soil conservation.

15 CENTS PER COPY — $1.25 PER YEAR

FOREIGN—$1.75 PER YEAR

25 percent discount on orders of 100 or more subscriptions mailed to a single address

OUR SOIL ★ OUR STRENGTH

TREE FARMING.—The American Tree Farm System of growing timber as a crop on private lands gained nearly 2 million acres during the first half of 1956, according to figures announced by American Forest Products Industries. Certified Tree Farm acreage in 43 participating States now totals nearly 40 million acres.

The Tree Farm program is an industry-sponsored movement to recognize private landowners who voluntarily protect their woodlands from fire, insects. disease, and destructive grazing and who harvest for repeated crops.

Georgia, with 3,795,743 acres, retains national leadership, followed closely by Florida with 3,603,014 acres; Alabama, 3,558,242 acres; Oregon, 3,524,931 acres; Texas, 3,389,881 acres; Arkansas, 3,372,-423 acres; and Washington, 3,322,994 acres.

Mississippi leads in the number of certified Tree Farms: 910. Texas is second with 831, and Alabama third with 663.

Three more States launched the Tree Farm program during the first half of this year—Vermont, Connecticut, and New York.

FRONT COVER.—Snow surveyors on their way to the next snow marker to make further measurements of the winter snow pack.

All orders go to the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Soil Maps For All Users

By F. M. ORSINI

A new kind of soil map will soon appear in the series of soil survey reports as a result of the combined efforts of the Department of Agriculture and State agencies working together on the National Cooperative Soil Survey. These maps will have an aerial photomosaic background with soil boundaries and symbols overprinted in red. The scale of most of the detailed maps will be 1:20,000 (3.17″ = 1 mile) with sheets 11½″ x 15″, which, when folded and bound into the report, will produce an atlas 9¼″ x 11½″. Each atlas will also contain a small-scale colored soil association map of the area.

Mapping of soils in the United States began in 1899. This continuing program has provided published maps for approximately 1,700 areas during the last 57 years. The majority are now 25 or 30 years old and, therefore, represent what was known about the soils a quarter of a century or more ago. The general scale of the early soil maps was 1″=1 mile, and in most cases they were printed on large and often unwieldy sheets.

Note.—The author is director of the cartographic division, Soil Conservation Service, Washington, D. C.

New type soil survey maps in pamphlet form are displayed above old type soil survey map.

In recent years there has been an increasing demand for larger-scale maps from which one can read accurately, in relation to local land lines, the kinds of soil in specific fields. Such maps are required for a variety of uses: farm and ranch planning in soil conservation districts, research and education programs of the Department and the State colleges, planning the agricultural phase of such programs as the Tennessee Valley Authority and the Bureau of Reclamation, tax assessment, predicting engineering problems on new highway construction, and the location of certain road building materials such as gravel, sand, and clay. For many other activities such as the Soil Bank, the Great Plains program, and the Agricultural Conservation Program, detailed soil maps are needed on which individual fields may be recognized clearly.

To meet these demands, the cartographic division of the Soil Conservation Service made a comprehensive study about 2 years ago of the economics of producing maps of sufficiently large scale to meet the needs of all of these users. It was found that larger-scale maps with an aerial photographic mosaic background could be produced by modern cartographic methods for considerably less than the old type, smaller-scale, colored maps. By using an aerial mosaic much drafting was eliminated, and at the same time a greater amount of background detail was included. The aerial mosaic shows such details as field boundaries, broad land use, minor roads or trails, and many others that could not be shown on a line base map.

It was recognized that as cultural and land use changes occur the aerial mosaic will not agree exactly with existing conditions. However, if this is clearly understood by users, the location of individual fields should still be as easy, or easier, than with the old type line maps, especially in those parts of the country that do not have regular section lines. We also were aware that it would not be as easy to get a view of the whole county with this new atlas type map as with the old line maps, but this objection was more than balanced by the awkwardness of the large sheets for use in the field. By including in the soil survey report a colored soil association map, generalized from the detailed maps, we have in some measure provided a picture of the county as a whole with the colors distinguishing the outstandingly unlike soil boundaries.

A sample soil map for a county incorporating these innovations was produced and reviewed in the Department, in the Land Grant colleges, and by a large group of soil map users. We found that nearly all map users preferred soil maps on sheets small enough to be folded and bound in book form. We had presumed that this new type map would have its greatest advantage in areas that are not sectionalized, yet we found that users in the Midwest preferred it to the old line maps even though location is fairly easy to establish on them. The Soil Conservation Service has adopted the new type map as standard. And the production program of this new type soil survey report is now well underway.

It takes from 12 to 20 months for any one map to travel the cartographic production line from mosaic construction, through manuscript compilation and map finishing, to final lithography. Thus, only a few such maps will be released during the next year. Watauga County, N. C.; Houston County, Tenn.; Brazos County, Tex.; and Pasquotank County, N. C., will be among the first to come off the presses.

The map construction techniques now being used include some interesting innovations in map making. The first step involves the preparation of controlled aerial mosaics through photogrammetric methods. Plastic sheets coated with an opaque white scribing surface are sensitized and the photomosaic image superimposed thereon in green dye. The soil survey detail is transferred to these green-coated sheets from the original soil survey sheets by the use of vertical reflecting projectors, or by tracing over a light table. Everything to be transferred that appears on the original soil survey sheets is scribed or etched in rough form on these green-coated manuscript sheets. Wherever a line has been scribed the opaque coating has been etched out leaving a clear line. Scribing is a relatively new development in map finishing that substitutes for fine line ink drafting.

The manuscript map is then adjusted for changes brought about by the soil correlation and is then edited. From these scribed manu-

Section of a new type soil survey map; scale, 1: 20,000.

scripts an image of the culture, drainage, and the soil survey delineations is printed on a yellow-coated plastic sheet for each of the colors that will be printed on the final map. Generally, on the published maps the culture and drainage will be printed in black, and the soil delineations and symbols in red, over the mosaic background. Thus, on one of the yellow sheets only the culture and drainage is scribed in finished form. On another one, only the soil delineations are scribed. These scribed sheets are used by the lithographers as negatives from which press plates are made.

The lettering and some of the more complex soil symbols are placed on separate, clear plastic sheets in exact registration with the final scribed yellow-coated sheets, so that they do not conflict with scribed lines or with lettering to be printed in black. A separate lettering sheet is made for those items printed in black and another one for those soil symbols printed in red. To insure uniformly high quality lettering, preprinted lettering with an adhesive backing is now used for this purpose. In order to keep the lettering costs low, a letter scribing instrument will be used to scribe the lettering directly on the final scribed yellow-coated sheets and reduce or eliminate the use of the more expensive preprinted lettering.

After editing, the negatives of the lettering layouts, the halftone negatives of the aerial mosaic, together with the scribed yellow-coated color separation sheets, are turned over to the lithographers for printing of the finished maps.

These modern large-scale soil maps permit publication of practically all of the detail mapped by the field surveyor, so we can transmit to all users the very latest scientific knowledge of the soil of a given area. The accompanying printed reports explain in detail the characteristics of the soils, and outline the alternative combinations of practices for the adapted crops, and the consequences of these practices on both crop production and the longtime productivity of the soil.

How Does Vegetation Affect Water Yield?

By GEORGE W. MUSGRAVE

THE great interest in watershed treatment and water as a basic necessity has intensified a technical question that has been growing steadily in recent years. If the vegetation on a watershed is changed, how will it affect the yield of water from that watershed? Some say the effects will be great; others that there will be virtually no effect; and many others take positions in between these extremes. In areas where water shortages are common, the question is of great importance.

This controversy, of course, stems from the fact that there are little experimental data today that apply directly to the problem. When we think of the wide difference between conditions in the humid East and the arid West, the complexity of the innumerable relations between climate, kinds of vegetation, and both water needs and supplies becomes apparent. Water yields differ with the seasons and differ with the soils, slopes, and other characteristics of the watersheds. Complete studies of these specific problems are indeed scattered and almost nonexistent.

Possibly the difference of opinion traces back in part to a famous classical study that actually was never intended to apply to this problem. This highly regarded study by Briggs and Shantz on the water requirements of plants was planned to find out how different kinds of plants differed in their use of water. Accordingly, the plants were grown in containers of soil, well watered and with the surface of the soil sealed against evaporation. Thus, escaping water in the form of vapor necessarily came from the plants—and none of it directly from the soil. The experiment showed that much more water was needed to produce a pound of dry matter in some kinds of plants than in others. It also showed that even where direct evaporation from soil was prevented, the water requirement of Grimm alfalfa, for example, was higher in those years when evaporation from a free water surface was higher.

That is to say, the daily and monthly rates vary with sunshine and temperature, amount of vapor in the air, and the amount of wind movement, whatever the type of vegetation.

Existing data also show a close relationship between the march of the sun and rate of water use. On days of normal weather the peak usage occurs a little after noon, or when the sunlight is near its daily maximum. Seasonally the peak usage occurs soon after June 21, or soon after the sun reaches its seasonal maximum.

Clearly, climate plays a big part in determining the amount of water used by plants.

But our watershed problems involve much more than use of water by plants. The yield of water is affected by other abstractions from precipitation, such as evaporation from soil and additions to deep-seated ground water. As one rancher expressed it recently, "Any fool knows that a tree uses more water than that thin grass cover, but the bare soil itself loses water too."

Here is an aspect of the problem that deserves more consideration than it usually receives. Suppose that on one watershed there is dense vegetation with little bare soil exposed to sun and wind. On an adjacent similar watershed there is sparse vegetation and much bare soil exposed to evaporative forces. Let us assume that the dense cover of plants uses more water than the scattered vegetation. That is, the transpiration or movement through the plants is greater in total when more plants are present (provided sufficient moisture is present to meet the demand for it). Surely that does not necessarily mean that the total of transpiration *plus* soil evaporation is greater where the vegetation is more dense. Obviously, evaporation from the unshaded, unprotected soil is greater than the direct evaporation from the soil beneath the dense vegetation.

Note.—The arthur is staff specialist (infiltration), engineering division, Soil Conservation Service, Washington, D. C.

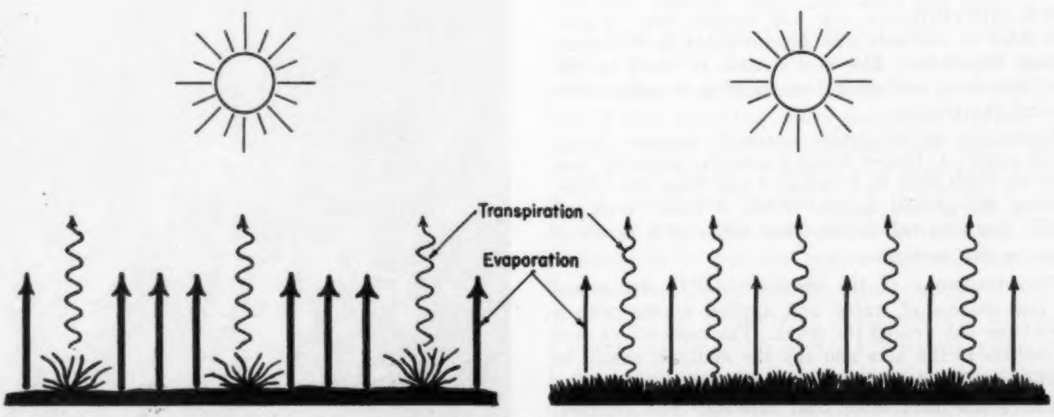
When we compute the vapor losses from the watershed with dense vegetation, we add to large transpiration losses a small amount of evaporation. On the other watershed we add to a large soil evaporation a small amount of transpiration. Thus, the water requirements of either type of vegetation are no positive indication of the *total losses* of moisture from the watershed. Nevertheless there has been more than one instance where such assumptions have been made. The comparisons of different kinds of vegetation reported by Briggs and Shantz sometimes have tacitly been assumed to specifically apply to the *total* losses from watersheds rather than that lost solely through vegetation.

It is often pointed out that the roots of plants can withdraw water from soil depths greater than can evaporative forces acting upon bare soil. This quite likely is true for those times when the moisture levels are higher beneath the vegetation. Once this water has been withdrawn by plant roots, can we expect much difference between vegetated and bare areas or densely and sparsely vegetated areas? If not, then we could expect that any appreciable difference, in areas of low rainfall, would be limited to relatively small portions of the year.

One of the most important facts that affect the amount of vapor losses from watersheds, but one often overlooked, is the amount of moisture that is present in the soil. On very moist soils evaporation is higher than on drier soil, as is attested by many experiments. Also, the amount of water passing through plants when soil is moist is greater than under dry conditions—all other things being equal. Existing data on depletion rates of soil moisture under different kinds of vegetation on relatively dry uplands bring out a principle that is generally applicable. These data show that differences between dense and sparse vegetation in their depletion rates are wider when the soil is moist. At lower moisture levels the difference is small, while at very low moisture contents there is no difference at all. Apparently, at low levels of available moisture even very sparse vegetation can use all of the water that is present.

Although there is very little direct evidence on the yield of water from watersheds having different densities of vegetation, there are some fairly well established principles that cannot be ignored:

(1) The annual total runoff, being a residue after certain abstractions from total precipitation, varies with both the amount and kind of precipitation and the amount and kind of abstractions—as to ground water, direct evaporation from water surfaces, and so on. The combined evaporation and transpiration (which has come to be called evapotranspiration) usually comprises the bulk of these losses. Since on any given site evaporation is higher than transpiration under sparse cover, while



How does the sum of evaporation from the soil, plus transpiration from plants, compare from ground with sparse vegetation to ground with dense vegetation? The drawing to the left illustrates possible happenings where sparse vegetation exists, while that to the right represents ground covered with dense vegetation.

under dense cover transpiration is higher but evaporation from soil is lower, it is apparent that no great difference in the sum of the two variables is to be expected.

(2) Since the differences in evapotranspiration for watersheds of differing cover density vary with the prevailing content of soil moisture, the application of consumptive use formulae derived largely from irrigated lands (i.e., high moisture-content areas) can scarcely be expected to apply to upland dry-farming conditions.

(3) The very great effect of climate on the yield of water is known but not always recognized. Large yields of water almost invariably come from areas of high precipitation, and especially of snowfall. Low yields occur under high temperatures, both annually and seasonally.

These are some of the things that affect water yield but are not always included in making evaluations of it. Even when we recognize these phases, we still do not have the means of making a precise numerical estimate of either water yield or evapotranspiration. We are, however, in a better position to see the directions of trend and to make closer evaluations than otherwise would be possible. Because of the real practical importance of the problem, we need to make the best possible evaluations and we need considerably more research on each phase of it.

MICE CONTROL.—A new and cheaper way to control mice in orchards was demonstrated in Wisconsin during September. The new control is based on the fact that mice will avoid trees lacking in grass cover around the trunks.

University of Wisconsin research workers L. G. Holm and F. A. Gilbert found a selective herbicide that kills all vegetation in a radius 3 feet from the trunk, leaving the ground barren. After 4 years' tests, no injury has occurred to the trees either as a result of mice or the herbicide.

Two teaspoons of the chemical, CMU, are mixed in two gallons of water and applied evenly with a sprinkling can around the trunk. The researchers used 10 pounds to the acre and say the material should be applied preferably before July 1 to control vegetation.

The researchers issue one warning. The chemical should be applied only around bearing apple trees. Younger trees may be damaged.

Double Duty Stubble

By CALVIN WIXOM

HE is not known as a particularly stingy sort of person, but Delwin "Bus" Theisen is a miser with his grain stubble. First he uses it to produce a crop of wheat, and then again to keep his topsoil on top of his own land.

"I don't set myself up as an authority on stubble mulch farming," Theisen says, "and I would not try to tell my neighbors how to run their farms. But I know what I have found out on my own farm. And there was one of my neighbors who came over once to look at my summer fallow and was surprised to find that I had stored more moisture than he had in his fallow.

"Then there was the time when I was just starting out with this trashy fallow idea. My Dad had a field just up the slope from one of mine. Runoff water from his field flowed

Note.—The author is work unit conservationist, Soil Conservation Service, Bozeman, Mont.

Oats growing in stubble mulch on Theisen farm.

Del Theisen stands by his tool bar equipped with chisels, while his son, Malcolm, kneels by the rod weeder.

onto my land. Dad was a good farmer in the days when clean, black fallow was something to be proud of. He is a believer in stubble mulch tillage now, but at that time he didn't like it and told me so. My brother, Cliff, is running the old place now and he is a stubble mulcher. But, to get back to this year I was telling you about when I had mulch on my field and Dad's was black. When the snow melted that spring the water and mud from Dad's field came down onto mine a little way and stopped. The stubble held my own runoff and his too."

Theisen's 680-acre wheat farm is located in the Gallatin Valley of Montana. Wind erosion is not much of a problem, but the spring runoff from melting snow sometimes causes excessive rill erosion on slopes and gullying in the waterways. Most of his cropland falls in land capability class III, due to slopes of 5 to 9 percent. He follows a simple crop-fallow rotation. The stubble is left undisturbed after harvest until the spring of the following year. His normal procedure is to use an offset disk or flexible tiller for the first operation, and then follow up with duckfoot shovels or a rod weeder. Bus has found that the duckfoot shovels will do a good job of killing weeds when his soil is too damp for the use of the rod weeder. He now plans to experiment with chisel points for the first operation in an effort to hold more of the stubble in, and on, the surface soil.

Seeding the new crop through stubble mulch became somewhat of a problem until Theisen purchased one of the new furrow opener type drills. This drill has shovels to open furrows for the seed. The seeds are dropped in ribbon-like rows 4 inches wide. The rows are 14 inches apart from center to center. Bus says he worried some at first about having these drill furrows on his sloping fields. His slopes are of such an irregular pattern that drilling on a strict contour is not possible. He has found, however, that each furrow carries its own share of runoff, and that the combination of individual furrows and the stubble incorporated into the soil does an excellent job of retarding erosion and leading the water into the soil.

"I used to think that deep tillage was necessary, too," he says, "I would put those chisel points down as deep as 12 inches in the belief that I was creating more moisture storage capacity. Now I am convinced that such deep tillage is a waste of power and may even cause a loss of stored moisture. I think the secret is at, or near, the surface of the ground. The problem is to get the water through the surface without soil sealing and runoff. Now I only run my equipment deep enough to keep it operating smoothly and to kill weeds, although I do sometimes put the chisels down a little deeper to break the hard sole caused by the rod weeder."

(Continued on page 131)

Keeping Grasslands Productive

By R. R. ROBINSON

No. 19

This is the nineteenth of a series of articles to appear from time to time in explanation of the various phases of research being conducted by the Department of Agriculture on problems of soil and water conservation.

GRASSLANDS usually are highly productive as long as good stands of adapted legumes are maintained. Therefore, even on soils not well adapted to legumes, it is desirable to include legumes in the original seeding and to fertilize and manage the crop to maintain the legumes as long as possible.

Fertilizers for good grass-legume mixtures usually consist primarily of phosphorous and potassium. However, the behavior of these two elements, both in the soil and the plant, are very different. Most soils will fix large quantities of phosphorus in forms not readily available to the plants. Potassium fixation, however, is not an important problem in most soils. Forage crops normally will remove from the soil about 110 pounds of potassium, but only about 15 pounds of phosphorus per acre per year. With heavy rates of potash fertilization, the potassium removal by the crop may be doubled. This luxury consumption of potassium is undesirable because it depletes the soil of potash without adding to the value of the crop.

Note.—The author is soil scientist, soil and water conservation research branch, Agricultural Research Service, Beltsville, Md.

Well managed whiteclover-Bahia grass pasture.

Luxury consumption of phosphorus on the other hand is no problem. In the first place, the plant will not absorb excessive quantities of phosporus; and secondly, a moderate increase in phosphorus content of the herbage insures an adequate level of phosphorus for the high producing dairy cow. Thus, liberal quantities of phosphorus are recommended at the time of seeding, particularly on soils that have not been adequately fertilized in the past.

Liberal quantities of potassium are equally important, but because of luxury consumption, potassium should be applied once or twice per year, depending upon the soil and the total yields produced. Soils that are low in available potassium and require high rates of potash fertilization obviously are the ones on which potash should be applied most frequently.

Legumes are particularly susceptible to potassium deficiencies in grass-legume mixtures because the grasses are strong competitors for potassium, and when the supply becomes limited, the legumes are the first to suffer. Fortunately, legumes show easily recognizable symptoms of potassium deficiency characterized by white spots along the margin of the leaves, followed by yellowing of the leaf margins, and eventually the entire leaf. By periodic inspections of fields, it often is possible to detect potassium deficiencies and apply additional fertilizer in time to save the legumes.

The interaction between potassium nutrition of the plant and bacterial wilt of alfalfa furnishes a further clue to the potassium status of the soil. Bacterial wilt partially clogs the roots and interferes with absorption of nutrients. Plants infected with bacterial wilt may show potassium deficiency symptoms when the level of available potassium is adequate for normal plants. If infected plants do not show potassium deficiency symptoms, it may be concluded that potassium fertilization is not yet needed.

Grazing and cutting practices are a major factor affecting persistence of good stands of legumes in grasslands. Following clipping, all forage crops draw upon stored food reserves in starting new growth. As the plants recover from clipping, the reserves are replenished. The various grasses and legumes differ widely in storage of reserves, extent of depletion following clipping, and rate of recovery.

Alfalfa is particularly susceptible to injury due to depletion of reserves if clipped too frequently. The reserves of alfalfa are stored in the roots, but are depleted rapidly following clipping and are not fully replaced until about the time the plants start to flower. If one persists in clipping more frequently, stands of alfalfa cannot be maintained.

The reserve cycle in ladino clover is entirely different from that of alfalfa. The stem of ladino clover grows flat along the ground and a leaf develops at each node. When growing with a vigorous grass, each new leaf arises in rather dense shade and elongates in an attempt to reach light. This type of growth tends to deplete the reserves of the clover, and if grazing or cutting is delayed too long the clover will become weak and may be lost. Also highly significant, is the fact that ladino clover stores carbohydrate reserves in the prostrate stems, or stolons, whereas the grasses store a large part of the carbohydrates reserves in the stubble, or lower part of the stem. Thus, close clipping or grazing will actually remove part of the reserves of grasses, but not of ladino clover. In fact, frequent clipping is necessary to maintain ladino clover in association with a vigorous grass. A general guide, therefore, is that the poorer the stand of ladino clover, the more frequently it should be grazed.

DOUBLE DUTY STUBBLE

(Continued from page 129)

Theisen was already experimenting with tillage for the control of erosion at the time he applied to the Gallatin Valley Soil Conservation District for technical assistance, and a conservation plan, in 1951. Since that time he has gained valuable experience and has been very cooperative with the district and the technicians of the Soil Conservation Service.

"I don't make any claim of increased yield," he says. "In fact, stubble mulch fallow might cost a few bushels. But, I am keeping my soil at home, and total yields over the years ahead should more than make up the difference."

Canyons Converted to Grassland

Western Iowa farmers spend as much as $300 per acre to convert huge gullies into usable grass waterways.

By GEORGE HOLMBERG, RICHARD L. PHILLIPS, and VERLE M. ARNOLD

WESTERN Iowa is a land of rolling loess hills. Most of the soil is a silt loam, is very porous, and produces bumper crops. But, it washes away like sugar in heavy rains if not protected with a cover of grass or legumes.

The pioneers who settled this area found the rolling hills covered by a sea of waving grasses. But when the valleys and hills alike succumbed to the plow, not only did the soil wash from the slopes but great gashes were cut in the valleys—gullies 50 to 100 feet wide and 20 to 40 feet deep.

It was these canyons that caused the technicians of the Soil Conservation Service to scratch their heads. Twenty years of experience had brought the answer to a lot of questions. But only in the last few years has headway been made in changing these huge, raw gullies into grassed waterways.

One example of what can be done with these gullies is on the E. H. Harms farm near Underwood in Pottawattamie County. Prior to 1944, one gully 30 feet deep and 80 feet wide had developed on the Harms farm. Trees had been planted but did not provide adequate control.

In 1943 and 1944, several earthen dams were constructed in the gully. A total of 344 acres drained into the gully at the point where it left the Harms farm. The drainage area includes all or parts of three farms, the operators of which are cooperators with the West Pottawat-

Note.—The authors, all of the Soil Conservation Service are, respectively, agronomy specialist, Sioux City, Iowa, area engineer, and work unit conservationist, Council Bluffs, Iowa.

Grass waterway on the Ernest Harms farm near Underwood, Iowa.

tamie Soil Conservation District. The ridge areas of all of the farms were terraced. By 1946 these earthen dams had collected considerable silt and it was apparent that they had outlived their purpose. It was decided that the most feasible solution now was to clear the trees, slope the banks, shape, and establish a grassed waterway.

In 1946 and 1947, Harms proceeded with his waterway project. He built a parabolic shaped waterway with a top width varying from 50 to 100 feet. The grade of the waterway averages 1 and 1½ percent and was designed for velocities of 5 feet per second. A drop inlet structure was built at the lower end to provide an outlet for the waterway. The waterway was heavily fertilized with manure and commercial fertilizer, and seeded to bromegrass and reed canarygrass. Some sodding of reed canarygrass also was done.

In 1947, a wet year, it was found necessary to tile the waterway to hold the vegetation. Since that time the waterway has functioned satisfactorily with little maintenance. Harms has reclaimed 10 acres of gullied area into usable hay or pastureland at a cost of approximately $300 per acre, as well as enhancing the beauty and value of his farm.

Bruce Baker, a cooperator with the West Pottawattamie Soil Conservation District, purchased a steep, hilly 160-acre farm near Council Bluffs, Iowa, in 1948. The hill land averaged from 19 to 25 percent slope and was cut up by 3 large gullies. In 1949, Baker started his terrace program and by 1953 had built 4 miles of terraces on these steep slopes.

Baker hired a local contractor with a bulldozer to blade in one of the smaller gullies in October 1951. The construction of this waterway involved moving approximately 9,000 cubic yards of earth. By 1953, Baker felt it was necessary to do something about the large gully that was bisecting his farm. It was not only destroying valuable land but was a menace to livestock. In fact, he had lost several head of cattle in the gully. Upon recommendation of local Soil Conservation Service technicians, Baker decided to work the gully into a grassed waterway. This gully drained only 32 acres, yet it was 1,800 feet long, was from 50 to 130 feet wide, and 20 to 48 feet deep.

Gully on the Bruce P. Baker farm near Council Bluffs, Iowa (above) before treatment, (below) after treatment and seeding to grass.

With technical assistance from local SCS technicians, Baker constructed a waterway designed for 4 feet per second velocity. The grade was divided into 3 sections using 9 percent slope at the top, 7 percent slope in the middle, and 4 percent slope at the bottom. The waterway averaged 40 feet in width. It emptied into a county road ditch which made a drop inlet stabilizing structure at the outlet necessary for safe discharge. It took 41,000 cubic yards of soil to fill the gully at a cost of $2,400 plus $700 for the structure, seeding, and fertilizing. Now, Baker has a beautiful grassed waterway in his pasture, with 5 acres of usable land, and the deathtrap for his livestock gone.

A complete soil and moisture conservation program is being carried out on the John Hanigan farm, located 2 miles south of Dunlap in Harrison County. This 320-acre farm has 160 acres of Class I land, and 160 acres of steep, hilly loess soils with slopes ranging from 10 to 25 percent. The plan for this farm was developed with the assistance of SCS technicians. It calls for crop rotations, contouring, terracing, grassed waterways, and a gully control structure.

Hanigan built more than a mile of level terraces in 1956. Also, the three farmers living above him terraced the parts of their farms that drained into the Hanigan gully. By having the upland area terraced Hanigan was able to change the large gully into a grassed waterway. He bladed 85,620 cubic yards of earth into the gullies in converting 17½ acres of gullied area into a bromegrass waterway. Large, temporary diversions were built to keep the water out until the seeding gets well established, at which time the diversions will be bladed out.

The gully control structure, a hooded inlet type, with 92 feet of 48-inch asphalt coated corrugated metal pipe acts as the waterway outlet. Two hundred twenty-eight acres drain through this waterway into Mill Creek.

These three farms illustrate what can be done with what seemed at one time an insurmountable problem. In each case the procedure was the same. The first step was to build level terraces on the upland to hold as much water where it falls as possible. The soil is so permeable that level terraces do a magnificent job and the soil needs all the extra moisture that these water savers can hold. They save soil too, naturally.

The next step was to establish a stable grade. This may be done with some type of permanent structure, or the waterway may be carried to a point where the grade is stabilized.

The waterway is then bladed to a grade and width that will carry the expected water without cutting out the grass cover. Usually a speed of from 3 to 6 feet per second is considered safe by the SCS technicians, depending on the amount of area that must drain into the waterway. It is sometimes necessary to build temporary diversion terraces at the head of the waterway to keep the water out until the grass becomes well started.

Waterways that are started in late spring or late fall may need a stabilizing crop such as rye or sudangrass. It can be used as a mulch when the final seeding is made.

A good seedbed is absolutely essential to success in starting these waterways. The soil must be firmed with a disk, spike-tooth harrow, and cultipacker. Fertilizer must be worked into the soil during the smoothing and firming process.

High quality, live seed is a necessity, and seeding rates should be 2 or 3 times that normally used for meadows. Don't use too many kinds of grass—in fact, one grass with a short-

Gully on the John Hanigan farm near Dunlap, Iowa; (above) before treatment, (below) after treatment and seeding to grass.

lived companion crop is usually enough. The seed must be sown shallow—¼ to ½ inch deep if drilled, and on top of the ground if seeded by hand. Nitrogen fertilizer or manure should be applied to the waterway often enough to maintain a healthy, dense sod.

Most of the waterways in the loess area are dry waterways—that is, seepage water does not run down through them. On these waterways, bromegrass usually forms the best sod. Reed canarygrass may also be used for "dry waterways."

If the waterway is wet, reed canarygrass is the best grass to use. It may be established by seeding or by using the "green hay" method. In using the hay method, the hay is mowed and hauled directly to the area and spread. Where the soil is soft, the hay may be tamped in or be pushed into the mud with a board. New plants start forming at the nodes within a few days, and within a month's time the plants should be 6 inches tall, with roots extending 8 inches into the soil.

On very wet waterways, tiling may be necessary in order to establish and maintain a stand of grass. Tile drainage is also essential on wet waterways to prevent damage during farming operations on adjacent land. Tile lines should be laid to the sides of the waterway, and at least 2½ feet below the surface.

All waterways, and particularly those as costly and important as these "canyon healers," will need good care to keep them safe.

NEGEV DESERT STUDY.—A study of the agricultural methods used more than two thousand years ago in the Negev desert of Israel will be conducted during the coming year by Dr. Philip Mayerson of New York University.

Dr. Mayerson teaches in the classics department of Washington Square College of Arts and Science. He left in August 1956 to study ancient ruins and agricultural irrigation systems in the Negev, check his findings from aerial photographs, and begin to establish criteria (never before established) for dating reservoirs, cisterns, and dams.

For several years Dr. Mayerson has been investigating the specific techniques that enabled the ancient inhabitants of the arid region to produce successful crops despite the low annual rainfall.

CEDARS COME BACK

Kansas farmer rejuvenates a cedar windbreak by severe pruning after snowstorm had almost demolished the trees.

By JULIUS H. MAI

"IN the spring of 1949 when I got through with these cedars, they looked like a cabbage patch after harvest; now they look like tulips." That is the way Clifford Lewallen, supervisor of the Thomas County Soil Conservation District, described the two rows of cedars as we walked through his farmstead windbreak last spring.

Before the big blizzard hit in November 1948, the 5-year old cedars were shoulder high. After the snowstorm they were buried under a snowbank 6 feet deep. The snow stayed on most of the winter. When it melted in the spring every cedar tree was broken to the ground. On close inspection Clifford saw that the top branches were stripped off. The main stems were bent and broken about a foot above the ground. He also saw that a good many of the lower branches on the stump were not damaged because they were just pressed flat on the ground under the weight of the snow.

Note.—The author is area conservationist, Soil Conservation Service, Colby, Kans.

Clifford Lewallen standing near a row of rejuvenated cedar windbreak.

Clifford Lewallen had no previous experience with a situation like this, but he knew that the broken wood would not grow again. So he decided to clean out everything that was damaged. When he was finished with the saw, the main trunk of every tree was cut off from 8 to 12 inches above the ground.

Side branches growing from cedar stump become upright leaders.

"Those two rows looked terrible, but I didn't know what else to do," said Clifford. "I thought sure they would never grow again. Before long though, I noticed that the remaining branches on the stump started turning up."

As time went on most of these same branches formed the new leaders. By actual count, each tree has from 3 to 6 leaders and they truly looked like the petals of tulips as Clifford so aptly expressed it.

Today those cedars are from 8 to 10 feet tall and there is complete closure in the rows. "As a matter of fact, I think they are denser and make a better windbreak than if they had not been broken down," Clifford remarked. Of course he does not recommend that undamaged trees be cut back, but he shows a good example of how well cedars will recover from snow breakage.

It is clearly evident that the success of this windbreak is due to the care Lewallen has given it. The space between the rows is cultivated throughout the summer to keep the planting free from weeds. Also, each spring he drags out the tumbleweeds blown in during the winter.

Lewallen's windbreak was planted in 1944 before he owned the farm. It is a 6-row, east-west planting, 650 feet long, on the north side of the farmstead. Beginning from the north there are 2 rows of Russian olive, 1 row each of honey locust and Chinese elm, and then the 2 rows of cedar on the south side next to the farmstead. The rows are spaced 20 feet apart. Within the rows the Russian olive are spaced 6 feet, the honey locust and Chinese elm 8 feet. The cedars are 6 to 8 feet apart.

When asked what he thinks of cedars now, Clifford said that more should be planted in every windbreak in this area. He believes they could well be planted on the north side for shrub rows. He concluded by saying: "I think they will be here and growing after all the broad-leaved trees are gone. They add color and make a more solid windbreak."

After 12 years there is evidence that the Russian olives in Lewallen's windbreak are getting a bit "leggy" and will in time lose the ground closure, shrub row effect. Some deadwood is appearing in the Chinese elm, which can be expected since they are rather short-lived trees. The deciduous, or broad-leaved trees and shrubs, initially make fast growth for early protection, but the evergreens are more permanent. Every windbreak should have several rows of evergreens and they should be so placed that they will make a good windbreak after the broad-leaved trees are gone.

CASH AWARD.—For his suggestion on how to save 3 man-days on each 80 acres of land leveled for irrigation, Herbert Belter, area agricultural engineer, SCS, stationed at Altus, Okla., has been given a cash award of $190 and a certificate of merit. Belter supervises the SCS engineering work in 5 work units of southwest Oklahoma.

Profits Through Water Spreading

A former Texan rejuvenates a South Dakota ranch by building an elaborate system of water spreading structures.

By J. ARTHUR MARTIN

FLOOD irrigation, or water spreading, is a primitive system of irrigation using storm runoff, and is almost as old as agriculture itself. It was encouraged years ago in this country through the desert claim provision of the homestead laws.

Anyone who has seen the spectacular results of a good spread of floodwater on a flat of western wheatgrass or alfalfa needs nothing more to make him a firm believer in the practice.

In 1947 a displaced Texan, Floyd A. Mooney, loaded up his family and moved to South Dakota where he had bought a ranch lying astraddle the Belle Fourche River 40 miles east of Sturgis. Most of the 16,000 acres are thin soiled river breaks—steep, knife edged ridges, and narrow, deep draws draining into the river. Over the ages the river has lashed back and forth between the bluffs and shale banks on either side, and in places built up flood plains that now lie 8 to 15 feet above the riverbed. Some of the larger draws have made deltas where they disgorge their loads of silt at their junction with the river. Others follow a cut bank channel to river level.

On Mooney's place are perhaps a thousand acres of river bottom land, that is nearly level but dry. Before cattle came into the country the river bottoms must have been meadows of stirrup-high wheatgrass. With the river as the only source of water, cattle stayed on the bottoms all summer long grazing them until, eventually, the grass was killed and replaced by annual saltbush. Here and there along the river a choice bit of bottom had been fenced for hay, protecting it from the concentration of cattle.

Note.—The author is work unit conservationist, Soil Conservation Service, Sturgis, S. Dak.

A family named Burton built the original ranch. They homesteaded on the river at the mouth of Haydraw, a 40,000-acre drainage that spread its floodwater naturally over a flat nearly a section in area. As the years passed, more of the watershed was plowed. The draw bottoms were grazed out and started to cut, and the silt load got bigger. At the mouth of the draw a delta built up, changing in size and shape with every flood. Burton built a ditch and floodgate in an attempt to get the water where he wanted it. But, silt filled the gate and ditch, and the draw started to cut out a new channel to the river, leaving half the flat high and dry. A few years' mowing of that area discouraged the wheatgrass, and it gave way to blue grama which was short enough to escape the mower.

When Mooney took the place over he decided halfway measures would not do. "We'll let the water flow out of the draw but on the bottom we will build a series of terraces or dikes on the level," he reasoned. "When the top one fills, water will have to spill around the ends and fill

Newly constructed diversion on the Mooney ranch, haystack in the background.

the next one below. We'll cover the whole flat with water and let it soak in; or, if it stands too long, we can open the dikes and drain the excess into the river."

Soil Conservation Service technicians from the Elk Creek Soil Conservation District helped him plan and lay out the dikes. After hiring a contractor to build the first ones, Mooney decided to invest in his own equipment. He bought a medium-sized crawler tractor with a bulldozer for dirt work and a tool bar for farming. After four seasons the wisdom of this move is evident. In addition to building 17 miles of dikes 3 to 4 feet high, the tractor has been used to build 15 stock water dams averaging 5,000 yards of dirt; grade 2 miles of road from ranch headquarters to the county road; construct a mile of heavy canal to divert flood flows to the desired locations; do many hours of plowing, chiseling, and subsoiling on cropland; move hay a stack at a time; and remove snow after winter storms.

Haydraw drains so much land that it has run some water every year since the Mooneys took over the ranch. Following a year of average snowfall, the draw runs for nearly a month.

Floyd A. Mooney in a field of western wheatgrass that was irrigated by his water spreading system.

This flow is relatively small, being ordinarily less than 25 second-feet. Mooney steers this water around "by hand," opening a dike here, closing one there, holding it on the ground for as much as 3 weeks because the 8-foot depth of heavy clay and shale beneath the surface absorbs water slowly, and the western wheatgrass and alfalfa are not killed by being under water for so long a time in the cool weather of early spring.

During late spring and summer the system must be handled differently. The expected flows then will come from heavy rains or violent thunderstorms and Haydraw will change within minutes from a dry watercourse to a surging, turbid flood stream. In June of 1956 such a runoff occurred just after the first cutting of hay had been put up. According to Mooney, so much water poured over the flat that the dikes were completely submerged, the only evidence of them being swells on the surface of the floodwater. The peak flow lasted less than a day, and had practically ceased after 4 days. Mooney expected the wild, unbridled fury of the flood to leave scarcely a trace of the dikes, and was overjoyed when he saw that the damage was so minor that it could be repaired in a matter of hours. Perhaps half of the dikes had a single hole cut through them—a gap of from 3 to 15 feet. The others had to be cut with the bulldozer to drain them, for the flooding occurred during the hot weather when alfalfa can be killed by standing under water for 24 hours.

On Haydraw bottom, Mooney has moved 25,000 yards of earth to build 7 miles of dikes. The cost, at 12 cents per yard, would be $3,000 or about $6.70 per acre for the 450 acres covered. Maintenance and operating costs to date have been less than 20 cents per acre per year. He is convinced that the system annually rewards him with 400 tons more hay than he could harvest without it. In addition, he gets an alfalfa seed crop that could not be grown without the extra water.

After building the dikes, Mooney drilled Cossack alfalfa into the existing grass with no seedbed preparation, planting 4 pounds per acre in the early spring. Within 2 years, the alfalfa made such a heavy stand that grass was not evident in it at a casual glance. First cutting alfalfa has yielded as much as 2 tons per

Aerial view of F. A. Mooney water spreading system.

acre. The second cutting is delayed until the prospects for a seed crop can be assayed. In 1954 and 1955, Mooney marketed 90,000 pounds of No. 1 certified seed.

In discussing the spreader system, Mooney said that since the dikes were completed in 1952, floodwater from Haydraw has reached the river only once. All the other flows have been absorbed by the meadow. It is estimated that over 450 acre-feet can be stored in the soil of this particular bottom. A storage dam of equal capacity would be an expensive structure, and short-lived because of silt.

The silt, which is rich in plant nutrients, may be deposited against some of the dikes as much as 6 inches in depth from a single runoff. The alfalfa is killed, but western wheatgrass will thrust itself through the silt and flourish. Mooney has reestablished alfalfa on such areas by broadcasting seed on them as soon as the water is off, at any time during the growing season.

Mooney has started developing spreader systems on 4 more bottoms, and has plans to do the same on 2 others. He says, "Some folks may think I'm crazy, but wherever it's possible to get the water and the soil together, I aim to make the effort. There are so many opportunities here that in my lifetime there is no chance to develop them all. I do want to leave the place a little better than I found it, and I hope the boys will continue on with the same idea."

HAWAIIAN SCOUTS PLANT TREES.—Boy Scout Troop 83 is sponsored by the Lihue Hongwanji Mission in Lihue on the island of Kauai, T. H. Up until the time that the East Kauai Soil Conservation District was organized, no merit badge was earned for soil and water conservation by any scout troop on Kauai.

In June of 1953, when the East Kauai Soil Conservation District was organized, Scoutmaster Tonaichi Fujii saw the opportunity for his Scouts to learn about soil

and water conservation. Soon after, Tamotsu Sahara, work unit conservationist for the East Kauai district arrived. Plans were made to teach the 27 boys about the various conservation practices on the East Kauai farms. In addition, tree planting was suggested as a living monument for the boys' part in doing a good deed, as well as to heal the eroded hillside on Kalepa Ridge.

Arrangements were made with Associate Forester Albert W. Duvel, of the Board of Agriculture and Forestry on Kauai, to furnish the necessary ironwood seedlings to plant in the erosion scars. The area selected was Kalepa Ridge, an eroded hillside a few miles from Lihue. Scouts with picks and shovels gathered at the scout room. Four hundred seedlings were planted that day. Tree planting on Kalepa will be carried on by each new group earning their merit badge in soil and water conservation.

Another item in the merit badge training was to teach the Scouts about the soils and the land classifications used in planning a farm.

On the Melvyn Mato farm, the Scouts studied the various land classifications and how the lands are classified according to their capability. Terraces were staked out, and Melvyn Mato demonstrated the construction of a terrace.

As news of the tree planting by the Scouts of Troop 83 reached other scout troops, they all became interested. Other boy and girl groups also organized tree planting projects.

Boy Scouts planting trees on eroded land in the East Kauai Soil Conservation District.

Cooperative Grass Seeding

A cooperative grass seeding project on fire-blackened land in Santa Barbara County, Calif., helps prevent floods and erosion.

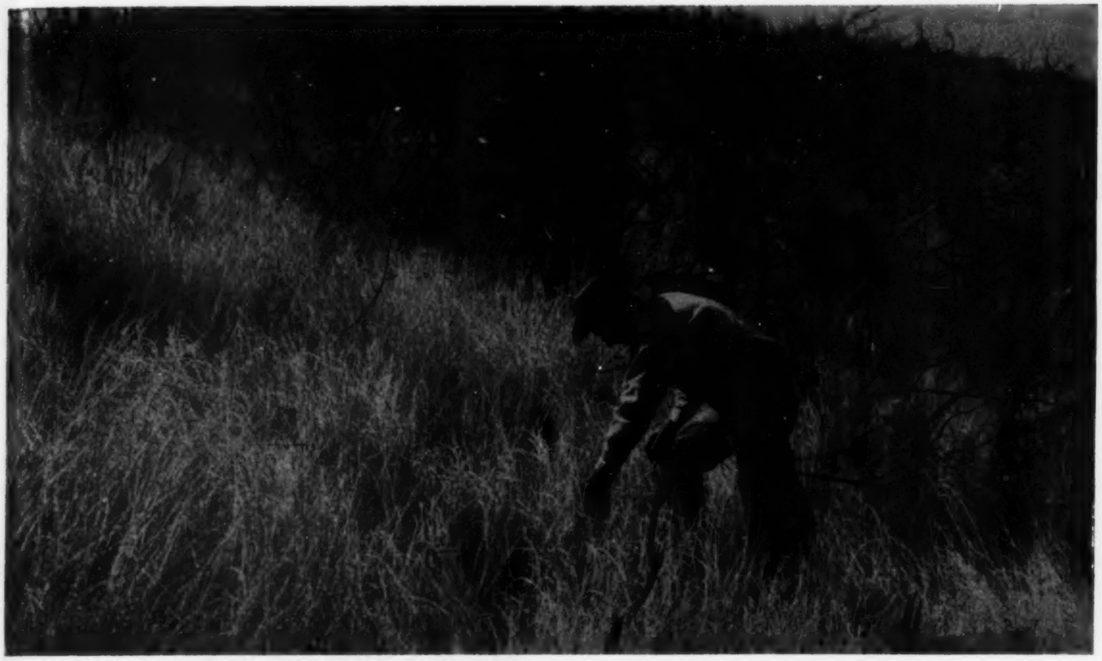
By R. H. MORS

CONDITIONS on July 10, 1953, added up to what foresters call "fire weather." Grass and brush fields were tinder-dry, the thermometer stood at over a hundred, and a hot wind was blowing from the north. Forest Ranger Ed Smithburg at Santa Maria and other personnel of Los Padres National Forest were worried. Before noon their worries were justified —first a puff of smoke, then a roaring fire rushing through oak-grass woodland and dense brush fields. Five days later, when the fire was out, 60,000 acres lay blackened, half of it privately owned and half national forest—all of it in the watershed above the rich Santa Maria Valley; and all of it in the Santa Maria Valley Soil Conservation District.

On July 30, a meeting was held at the ranch home of John Fesler, in the burned area, to discuss measures for protection against erosion, flooding, and deposition that were sure to follow. This meeting was called by Soil Conservation District President Ernest Righetti and was attended by local ranchers and officials of all Government agencies concerned, as well as a reporter from each of the local papers. All present participated in the discussion of protection and rehabilitation measures.

Subsequent meetings were held in the soil conservation district office and at the Forest Service Pine Canyon guard station. These meetings were attended by representatives of all county, State, and Federal agencies that the district directors felt might contribute toward the planning and execution of a flood control and erosion prevention program.

Note.—The author is work unit conservationist, Soil Conservation Service, Santa Maria, Calif.



Norman Farrell of the Forest Service checks grass planting for brush seedlings.

A field survey and report by Soil Conservation Service engineers showed that debris dams would not be economically feasible.

The U. S. Air Force made a special flight and furnished the soil conservation district with a complete set of overlapping aerial photos covering the burned area. The farm advisor, district ranger of the Forest Service, and work unit conservationist of SCS spent 2 days in the field discussing a proposed seeding program with each of the 20 ranchers in the burned area.

It was decided to limit the national forest seeding to slopes of 50 percent or less, that were in dense brush before the fire, and that were burned clean. These were delineated on the aerial photos. They added up to 6,000 acres. George Roskie, resource officer for Los Padres National Forest, wrote a report to the Secretary of Agriculture requesting $15,900 emergency funds for a seeding program on this area. The full amount was granted immediately.

Forest Supervisor L. A. "Gus" Rickel negotiated a contract with a helicopter operator for seeding the more difficult sites. Ranchers were invited to have private lands seeded by the helicopter at contract price. Approximately 2,000 acres of private land were seeded by plane, helicopter, horseback, and afoot. All of the seeding was completed in October, before there was a rain on the ash. Seed mix for the national forest seeding was 5 pounds of annual ryegrass and 2 pounds wild oats per acre. A variety of seed mixes were used on the private land. Some included legumes and perennial grasses, as well as the basic ryegrass.

The seeding was found to be highly satisfactory the following spring. Grazing on both national forest and private lands has been conservative, and there was a good volunteer stand of grass in 1955 and 1956. By the summer of 1955, however, brush seedlings and sprouts were beginning to take over the areas that were in brush before the fire. It was apparent that further action was needed. That fall, the ranchers of the area, with guidance from Farm Advisor Geiberger, formed the Sisquoc Range Improvement Association. This is an association of ranchers organized to develop and execute a brush and range management program for their lands. Meetings are held the second Monday evening of each month in the Sisquoc Grange Hall. Attendance at these meetings

usually includes 15 to 20 ranchers, the farm advisor, district ranger, a representative of the California Division of Forestry, the county fire warden, the county office manager for ASC, the SCS work unit conservationist, and interested visitors.

The Range Improvement Association's program for 1956 included a series of brush control burns, followed by seeding and range management. Plans include spraying with brush killer later if necessary.

DISTRICT PROFILE

JESSE FAIRFIELD of MASSACHUSETTS

TO understand what Jesse H. Fairfield has done for soil conservation in Massachusetts, you have to know Berkshire County. Farmers are still reckoning with the glaciers—they must farm in between boulders, make their way through 400,000 acres of trees, and thread their agriculture along the floors of countless steep valleys.

Also, this is Tanglewood Music Festival country, and the landowner you're dealing with may be the first violinist of the Boston Symphony Orchestra, or a millionaire patron of the arts. On the other hand, you may run into recent arrivals from overseas, eagerly tilling New World soil.

That's the arena in which Jesse Fairfield, now 78, has led a remarkable resource effort for the past decade. In spite of odds, Berkshire's pioneering, under Fairfield's leadership, has had nationwide results.

Wherever farmers pay cheaper fire insurance rates because of their handy farm ponds, they can thank early action of the Berkshire Soil Conservation District. It was Fairfield who gathered evidence of the value of ponds for fire protection from every district in a six-State area. He presented the package to the New England Fire Insurance Underwriters Association. "If you cut rates for items like good housekeeping," said Jesse, "how can you overlook a 300,000-gallon water supply right near the dooryard?"

The insurers couldn't, really. For the past 6 years, more companies have given credit for all water sources that help rural fire-fighting. This way, some Berkshire dairymen have saved as much at $300 in insurance premiums per year. As the news has spread, Fairfield has carried on an ever-livelier correspondence with interested farmers all over the Nation.

The spry cairman has kept a sharp eye on the welfare of district cooperators—on occasion, doing battle with the giants. "I like to tackle the big boys," Jesse tells you with a wink. And what he calls "the district's first big project" is a fair example. That was when the dam of a large paper mill used to regularly back water up the brooks along the Housatonic River.

"Every spring, our farmers would have dipper ducks swimming where they needed to take hay," is the way Jesse puts it. He and the other supervisors shocked the paper mill into action with a bold request that floodgates be opened whenever hayfields were threatened. On top of that, Jesse and the board would go down and stand on a bridge near the mill, in plain sight, to see it done. Nowadays, farmers watch flood gages along the brooks. Emergency readings are called direct to the district office in Pittsfield.

Jesse saw to it that the district gave television one of its first farming "spectaculars." He

Jesse H. Fairfield.

helped direct the mammoth face-lifting of the Walter Hadala dairy farm at Adams. There, 30,000 visitors saw a vast fleet of machines do 5 years' soil conservation work in 1 day. Mobile camera units transmitted the pageant to the top of Mount Greylock, for relay to WBRK in Schenectady, N. Y.

Passion for details has typified Fairfield's leadership; has given Berkshire a beehive of resource attention. The district's tree farms are the pride of Massachusetts. The district-managed nursery has backed woodland work with production of more than 300,000 tree and shrub seedlings.

Located at the headwaters of 13 large watersheds, Berkshire is working hand-in-glove with adjacent districts in Vermont, New York, and Connecticut in this phase of land protection.

Berkshire farmers have won warm friends among Bay State sportsmen for their support of public shooting grounds and game improvement. Farm neighborhoods have installed hedgerows and borders to invite wildlife. And, each summer, Bill Hill, Soil Conservation Service work unit conservationist of Berkshire, gives a hand to young sportsmen in the Massachusetts Junior Conservation Camp at nearby Beartown.

Unending variety in the district program is a good reflection of Jesse Fairfield's life work and interests. He operated a 300-acre dairy farm at Richmond until recently, and still farms a 30-acre patch, raising his own grain for a few head of beef, sheep, and a flock of hens. "I don't feel right unless I climb on a tractor once in awhile," is Jesse's explanation.

For half a century, he has been treasurer of the Richmond Telephone Company. Meanwhile, he led milk producers in a price campaign for dairy products; won a U. S. Department of Agriculture award for aiding the Berkshire County Agricultural Stabilization Conservation Committee; put in more years than he can remember as a selectman for his hometown.

When soil conservation was taking root in Berkshire, Jesse passed the hat among his neighbors. With $145, he built a small, bypass pond to protect six homes, the town hall, and Congregational Church. Since completion, the pond water has helped put out three fires.

—BERNHARD A. ROTH

REVIEWS

THEORY AND DYNAMICS OF GRASSLAND AGRICULTURE. By Jack R. Harland. 281 pp. Illustrated. 1956. New York: D. Van Nostrand Co., Inc. $6.75.

IN this excellent book the author lays out an integrated set of basic theories of grassland agriculture derived, in part, from geology, plant and animal physiology, soil science, plant taxonomy, and ecology and, in part, from direct research and experience. He illustrates how these theories are used, along with pragmatic testing, to develop the best local system for a ranch or farm. He makes no attempt to cover all local systems, nor could he in a book of this size. As it is, he covers an amazing amount of ground.

The author draws from research and experience throughout the world in developing the basic principles. Although he tells us something of practices abroad, especially in New Zealand, the management suggestions are developed in most detail for ranges in the Great Plains and somewhat less for other ranges and for pastures.

This reviewer would give somewhat different emphases to a few of the many facts, principles, and ideas brought forward. For example, in explaining why some excellent pastures in western Europe are almost never plowed, I should have emphasized the harm that plowing does to the natural water channels produced by the soil fauna in ill-drained clay soils. Further, I should have liked more explicit suggestions for range evaluation and classification where the climax plant association cannot be discovered or where, when known, it is not a reasonable goal for range management. Each reader will probably find that he would also change the emphasis a little here and there. But considering the task he has undertaken, the author has done a masterful job.

For the scientist or technician concerned with grassland in any way, reading this book will be a rewarding experience. It will give him a brief review of his previous studies of plant, soil, and animal science and bring him up to

date on recent progress. Equally important, he will see more clearly how the many facets of scientific knowledge relate together and where some of the most serious gaps in that knowledge lie.

Every agronomist, range conservationist, and soil scientist should benefit a great deal from this book. And so can those farmers and stockmen who have had opportunities for at least some advanced training in the basic sciences. Yet, without such training and familiarity with the terms and symbols of chemistry and biology, some of the book will seem obscure.

—CHARLES E. KELLOGG

PILOT CONSERVATION SCHOOL.—The Brockway-Snyder-Washington Joint School in Pennsylvania has started a "Pilot Conservation School." Through this pilot school all sixth grade pupils get acquainted with the conservation of natural resources. During the last 2 years 250 took the course.

The pilot school was developed in 1954. The State Game Commission, Fish Commission, and Department of Forests and Waters, and the Soil Conservation Service helped work out the course of study. They also furnished teachers along with the Extension Service.

The classes were taught through lectures, demonstrations, movies, slides, and a farm tour. The sponsors concentrated instruction within 3 days, with the regular teachers taking part throughout. They spread the actual conservation instruction, however, over a longer period. The regular teachers prepared their pupils for the concentrated course in advance. They followed through for a long period afterward.

Both years the instructors took the pupils by bus to the Ross-Leffler School of Conservation, owned by the Pennsylvania Game Commission. They divided the classes into groups of about 30 each. They broke these groups into smaller units for class and field trip purposes. Each pupil had a day of instruction on soils and soil conservation, half a day on forestry, half a day on fish culture and laws, and a day on biology. The biology instruction covered game identification and game laws. Conservation, of course, was always the central theme.

The physical culture instructor held regular recreation periods for the pupils. The art instructor took part to obtain materials to use in her classes. Home Economics contributed the lunch. The English instructor added to the value of the course with themes and talks on conservation.

The soil conservation part of the course covered soils, slope, erosion, and erosion control. The instructors used sildes to illustrate their lectures, emphasis being placed on local conditions. They also showed a conservation movie.

Each year the pupils made a tour of Charles Mortimer's nearby farm. They saw conservation practices they had studied in the classroom. They observed improved pastures, several kinds of forage grasses, waterways, terraces, wildlife borders, farm ponds, tree plantings, and selective woodland cutting.

To finance the program, the Jefferson County Soil Conservation District, the Brockway Sportsmen's Club, the Brockway school system, the Jefferson County commissioners, and about 30 individuals contributed either cash or materials.

—WATSON A. LUPHER

SIXTY POUNDS PER CALF.—"My calves averaged 60 pounds heavier last fall due to conservation practices on my land," reports Stanley Good, prominent rancher from Kenna, N. Mex.

Good had both hard and sandy range sites in the same pasture. The only watering place was on the hard land. Even though the sandy land grass came out earlier in the spring, the cattle would not go back on it because of the distance from water. Proper use of the sandy range was not obtained and the hard land was overgrazed.

With his problem in mind, Good sought assistance from the Border Soil Conservation District. Soil Conservation Service range specialists helped him reorganize his pastures and develop a grazing plan.

New fences following the site boundries were built, and old ones were removed. Water was piped from the hard land to the sandy land, and drinking tubs were spaced at regular intervals along the line.

"Through these two conservation practices I was able to get uniform use over the entire pasture," says Good. "In the future I plan to do some more fencing and extend the pipeline into a lower pasture. The additional weight on my calves more than pays the cost of the practices as well as protecting my range."

—JAMES MORGAN